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No. 107

THE WEYMANN-LEPÈRE W.E.L. 10 OBSERVATION AIRPLANE (FRENCH)
A High-Wing Monoplane

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Editor's Note: The following is a detailed description of the Weymann-Lepère airplane W.E.L. 10. We considered it useful to give this space to the most recent production of a high-class engineer whose efforts for many years had been impeded by poor industrial conditions. It will be seen that, in the W.E.L. 10, Mr. Lepère has carried further than was ever done before the application of ideas capable of advancing airplane construction to the industrial stage. The structure of the W.E.L. 10 is homogeneous, the members incapable of misadjustment, with a grouping of partial assemblies interchangeable to an unprecedented degree.

Principles of Construction

The two essential principles applied in the construction of the W.E.L. 10 relate, one to the covering and the other to the constitution of the wings by means of interchangeable box sections strung on the spars.

Covering.— The Lepère covering (Fig. 1) consists of narrow metal sheets— 1 of suitable thickness corrugated longitudinally near one edge, so as to form a reinforcing rib 2. The assembling of these sheets by rivets 3 and 4 (Fig. 2) render it possible to obtain surfaces of as large dimensions as may be de-

*"Le monoplane de reconnaissance Weymann-Lepère W.E.L. 10" from L'Aéronautique, November, 1929, pp. 362-368.

sired. The use of narrow sheets, 300 mm (11.8 in.), for example, which are naturally smoother and of more uniform thickness than wide ones, facilitates the riveting. Moreover, small sheets buckle less than large ones. The corrugations may be either outside or inside the covering, according to whether it is or is not possible to orient them in the direction of the wind.

Figure 3 represents a wing constructed on this principle. The inside corrugations transmit the stresses from the wing covering to the transverse frames or ribs secured at intervals to the spars 6 and 7. When the interval between two successive ribs is too large for the inside corrugations to prevent any deformation of the profile, stiffeners 7, in the direction of the wind, are attached to the outer surface of the wing (Fig. 4). The sheets may be applied with the corrugations outside and parallel to the wind. In this case the sheets must, of course, be bent to the desired profile (Fig. 5).

Figure 6 represents a fuselage covering. The corrugations are placed outside, so as not to be interrupted by the interior frames.

This manner of covering renders it possible to make conical wings. It is only necessary to assemble the sheets in such a way as to form elementary trapezoids whose juxtaposition forms conical segments, or to vary the angle of the end sections.

The wing.— In general a wing, right or left, forms an inseparable whole. The wing of the W.E.L. 10, however, consists

of an assembly of indeformable and interchangeable box sections 7. These sections are strung on the spars 5 and 6 and secured to one another and to the wing spars by riveting. The W.E.L. 10 has a main spar and a discontinuous secondary spar, as will be explained later.

Structure of a box section.— Each box section (Figs. 8 and 9) has a leading edge 8, a trailing edge 9, a covering and two bulkheads 11. The covering is attached to the leading edge 8, to the secondary spar 6 (or to the trailing edge, if there is no aileron) and to the frame 12. The sheet-metal bulkhead 11 is riveted to this frame. Each bulkhead has an orifice 13 for the passage of the main spar.

Assembling the box sections.— Channels 14 (Figs. 8-9), designed to receive the flanges of the I spar, are riveted to the inside of the covering. The box sections are then strung on the spar. The bulkhead of each section, remaining visible after being put in place, is riveted from the outside (Fig. 10) with the aid of the angle 15 to a vertical channel which has first been riveted to the web of the spar. The edges of adjacent bulkheads, which project beyond the surface of the wing, are riveted together (Fig. 9, section a b) so as to transmit the torsional stresses correctly. Lastly, the leading and trailing edges of the different box sections are joined together.

Analysis of the functions.— The covering withstands the stresses parallel to the plane of the wing and also the resultant of the torsional moments. The former are absorbed by the girder whose flanges are the leading edge and the secondary spar, and whose web is the covering. Toward the latter the covering functions like a tube and transmits the torsional stresses from one box section to the next by means of the riveted joint. The vertical stresses on the covering are transmitted to the spar by the vertical gussets. The spar is thus subjected only to the forces parallel to its web. Deformations produced by the action of the different forces on one of these two systems should not appreciably affect the other, there being no rigid connection between them, because the covering is not riveted directly to the spar.

A e r o d y n a m i c s

Wing.— The Lepère wing profile No. 8 (relative thickness 12%) was plotted according to the method of Mises. The C_{m0} is zero with reference to the leading edge, corresponding to a center of lift located at 25% of the chord from the leading edge. Nevertheless, the drag and the C_z maximum are comparable to those of the best profiles known. The fixed center of lift and the stressed covering enabled the construction with only one main spar. The wing is rectangular and the thickness uniform, excepting at the tips, which are trapezoidal and of decreasing

thickness. The aspect ratio of 6.7 is the highest which could be adopted with regard to the possibilities of construction.* The cutaway above the pilot's cockpit has been reduced to a minimum.

The ailerons are long and narrow, 5.4×0.3 m (17.7 ft. \times .98 ft.). Their range of motion is only $\pm 8^\circ$. This arrangement, already employed on all-metal airplanes, renders it possible to obtain a very high ratio of the rolling moment to the turning moment with very easy operation of the controls and prolongs the lateral control of the airplane beyond the angle of maximum lift.

Radiator.— The radiator is sunk very neatly into the wing. Two advantages are generally expected from this arrangement. First of all, an improvement in the quality of the airplane, due to the lessening of the drag. Next, the automatic regulation of the temperature of the water due to the fact that the maximum power required of the engine corresponds to stalled flight, i.e., the maximum circulation of air through the radiator, the minimum power corresponding, on the contrary, to diving flight. Though the results hitherto obtained with tubular radiators installed as shown in Figure 11 had made it possible to obtain a certain degree of automatic regulation, the presence of the cutaway had appreciably impaired the efficiency of the wing. Eddies were created in the zone a b c and the air filaments struck against the edge d e.

*Cf. "L'influence de l'allongement de voilure sur les performances des avions" by G. Lepère, L'Aéronautique No. 112 (September, 1928), p.313.

On the W.E.L. 10, the radiator 7 (Fig. 12) is not located in a simple cutaway, but in a slot 6 of 1.4 m (4.6 ft.) span. The form of this slot was designed so as not to diminish the efficiency of the wing. At 8 there is a shutter for closing the slot in whole or in part. This shutter is required, however, only on certain airplanes having to fly under very large temperature variations. This manner of mounting the radiator in the wing, by enabling the passage of a certain quantity of air through the slot, diminishes the interaction between the wing and fuselage, due to the great angle of setting required by the Lepère No. 8 profile. In the case of the W.E.L. 10, therefore, this arrangement affords an additional advantage. According to the tests made in the Saint Cyr laboratory the efficiency of the wing was not impaired, the polars with and without the slot, with and without the radiator, being identical.

Fuselage.— Its tapering shape was determined by the requirements of minimum drag and maximum efficiency of propulsion, in order to render it suitable for military use.

Struts.— There is a single strut for each half of the wing, corresponding to the single spar. The diameter of the strut being that of a double strut, its drag is reduced 50%. The secondary struts (which work in compression only in the event of dissymmetrical stresses) are streamlined tubes of small diameter. The interaction of the struts with one another and with the fuse-

lage has been reduced to the minimum by avoiding sharp angles.

Landing gear.— Its drag has been reduced by placing it below the propeller slipstream.

Tail surfaces.— The horizontal empennage has a symmetrical biconvex profile, a trapezoidal ground plan, a span of 3 m (9.84 ft.) and a chord of 1.1 m (3.61 ft.). The stabilizer occupies half the chord, a proportion which increases the controllability and which is permitted by the fact that the empennage was designed to be always adjusted in the vicinity of zero lift. The reaction on the stabilizer is therefore always very small. The vertical empennage is also trapezoidal. The rudder is rectangular and balanced. The quite large relative thickness (10%) of both empennages made it possible to eliminate entirely the struts and the consequent drag, while having a profile with a minimum drag. Moreover, the adoption of a profile with C_{m_0} zero diminishes the stresses on the tail surfaces and fuselage in diving or in flying at high speed.

D e s c r i p t i o n

Wing.— The wing is divided into five sections: a central section of 2.5 m (8.2 ft.) span containing the slot in which the radiator is mounted; two main sections of 5.5 m (18 ft.) span; and two end sections of 0.8 m (2.6 ft.) span. The spars of the two main sections (Figs. 13 and 14) are alike and symmetrical

with respect to the middle strut attachment (Fig. 14). Each main section of the wing is composed of six box-like sections of 0.78 m (2.56 ft.) span and a special box section including the strut attachment. The box sections are all alike and are constructed as shown in Figures 15-19.

Each main section is mounted by sliding, after engaging the spar in the channels of a box section. After each box section is put in place, the two adjacent bulkheads are riveted together and the visible bulkhead is riveted, by means of gussets, to the web of the spar. The end sections are joined to the main sections by means of the spar fittings and the junction is assured by riveting the adjacent bulkheads together. The right and left wings are alike and interchangeable.

Ailerons.-- The ailerons (Fig. 20) are likewise composed of box sections. This provides a certain degree of flexibility which assures the correct alinement of all the hinges, whatever the tolerances or deformations.

Struts.-- The main strut for each half-wing is a streamlined duralumin tube attached to the spar by a fork and by a bolt passing through the web (Fig. 14). All the other struts are tubes of 28 to 50 mm (1.1 - 1.97 in.) diameter.

Landing gear.-- The landing gear has a broad track gauge of 2.4 m (7.87 ft.). Each wheel is mounted on an interrupted axle

which transmits the reaction directly to an oleopneumatic shock absorber.

Fuselage.-- The fuselage (Figs. 21-24) is divided into three sections, which are partial assemblies made on templates.

The engine group is independent and interchangeable and is attached to the fuselage at four points (Figs. 29-30). The central section supports the wing struts. It contains the cockpits for the pilot and observer, as also the dumpable tanks. Its framework consists of four straight and parallel tubular longerons (Fig. 6). They are braced by transverse frames and each face of the fuselage is stiffened by the covering.

The tail section is constructed like the central section to which it is joined by eight fittings, two at each angle (Fig. 24).

The horizontal empennage is composed of a trapezoidal one-piece stabilizer and an elevator consisting of two like and interchangeable parts. The stabilizer can pivot about an axis situated near its leading edge and is held at its rear edge by a bell crank connected by a rod to the operating lever.

The vertical empennage is adjustable on the ground. The dual rudder control (Figs. 25-28) is perfectly rigid, having neither cables, chains, nor gears.

The elevator, rudder and stabilizer controls are dual. All rotating parts are provided with "Tecalemit" oilers.

Views of the complete airplane are given in Figures 31 and 32.

C h a r a c t e r i s t i c s

Span of wing	15.10 m	49.54 ft.
Length	11.50 "	37.73 "
Height	3.10 "	10.17 "
Wing area	33.75 m ²	363.28 sq.ft.
Span of radiator slot	1.40 m	4.59 ft.
Track gauge	2.40 "	7.87 "

Translation by Dwight M. Miner,
National Advisory Committee
for Aeronautics.

Legends for Figures

Fig. 13.— Wing spar. Strut attachment. Webs of thick superposed duralumin plates. Duralumin bearing bolted to web. The spars of each wing section are symmetrical with reference to this attachment.

Fig. 14.— End of spar. Riveted duralumin T flanges and plates; corrugated sheet-duralumin webs; steel fittings staggered to form solid of equal resistance; terminal fittings of thick sheet duralumin. The terminal fittings serve to join the main section either to the end section or to the central section.

Figs. 15-19.— Box section of wing. Fig. 15. Wing section before applying bulkhead. Covering reinforced externally by corrugated strip. Flange for riveting adjacent sections together. Fig. 16. Assembly of covering sheets. Fig. 17. Trailing edge of wing section with closing channels. Fig. 18. Leading edge of a wing section. Fig. 19. Channel for receiving flange of wing spar.

Fig. 20.— Assembly of two aileron sections.

Fig. 21.— Assembly of tail section of fuselage to central section.

Fig. 22.— Joint of a main frame showing attachment for main wing strut and landing-gear strut.

Fig. 23.— View of same joint from inside, without strut attachments.

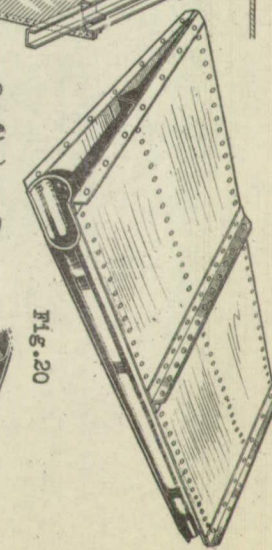
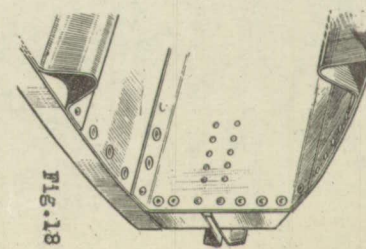
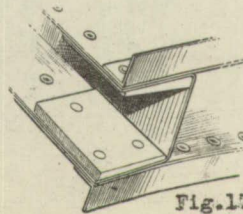
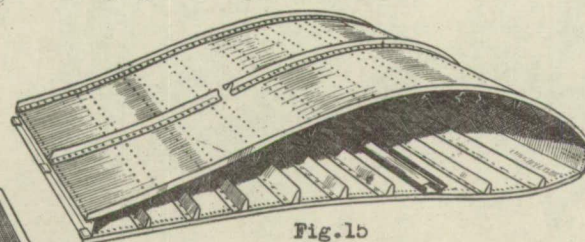
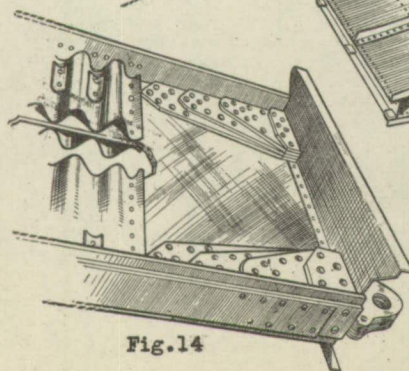
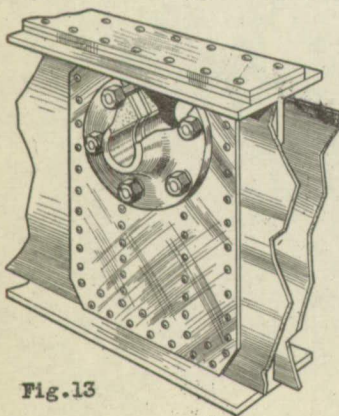
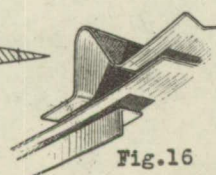
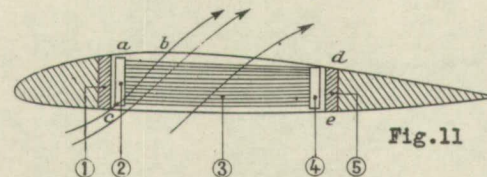
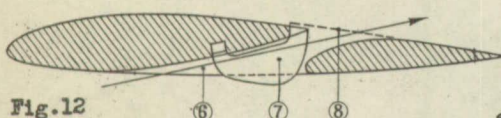
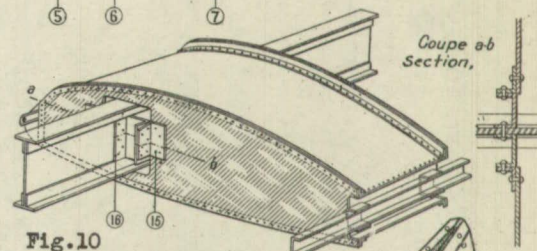
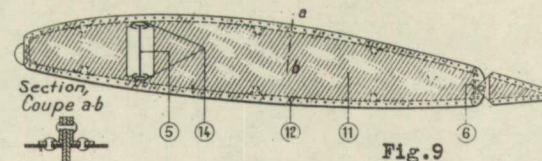
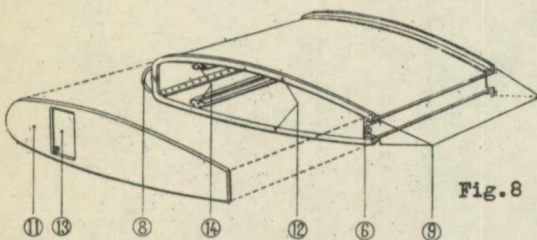
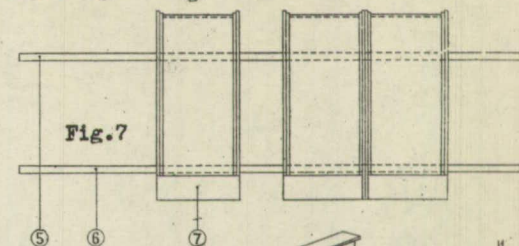
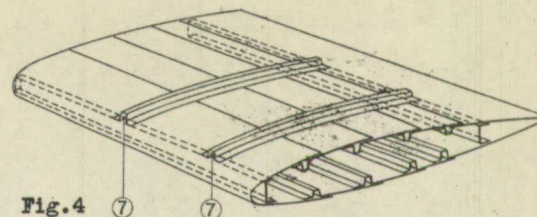
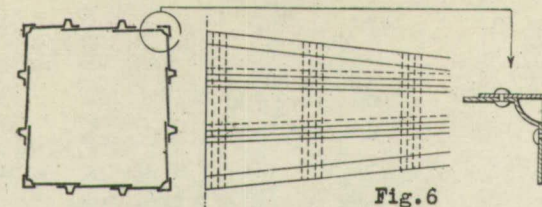
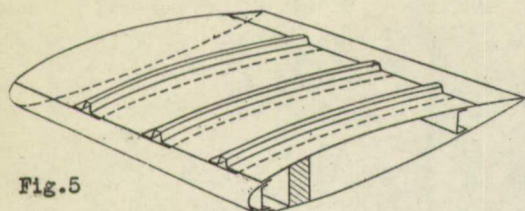
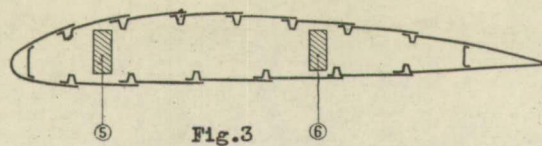
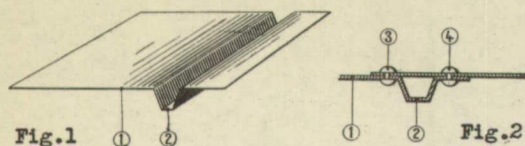
Fig. 24.— Fuselage joint showing end of floor girder.

Fig. 25.— Control assembly made separately and attached to fuselage by bolts. The right-hand lever operates the elevator and ailerons. The other one regulates the stabilizer. Rudder bar at front end. No. 1, aileron control lever; No. 2, lever limiting motion of ailerons.

Fig. 26.— Attachment of rudder control.

Fig. 27.— At top, the rudder bar; at 3 the attachment for the second removable control stick.

Fig. 28.— Levers for operating elevator and rudder. Levers riveted to the hubs; axles of tubular steel; "Tecalemit" oilers.



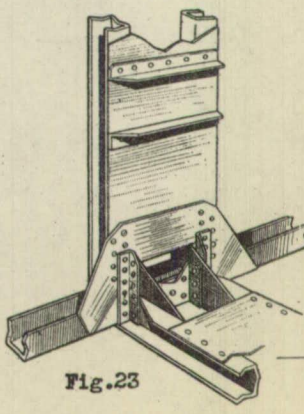
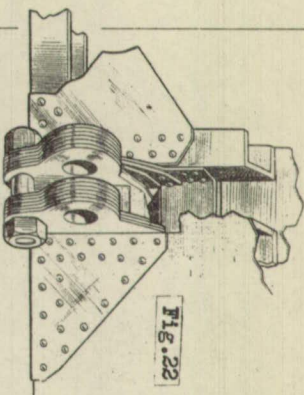
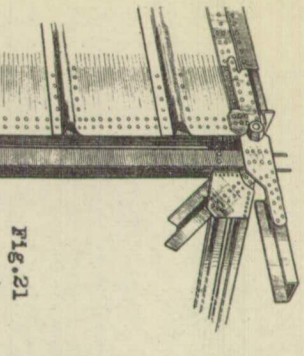


Fig.21

Fig.22

Fig.23

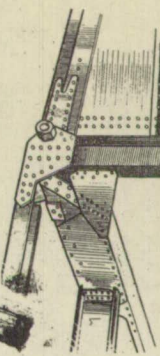


Fig.25

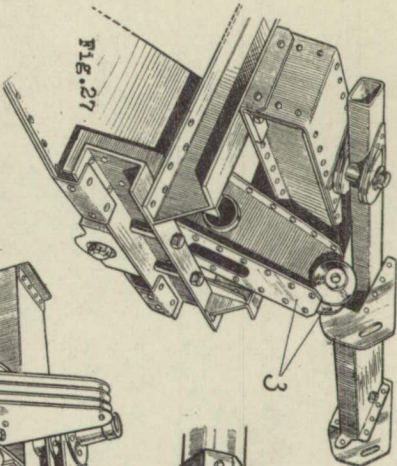


Fig.27

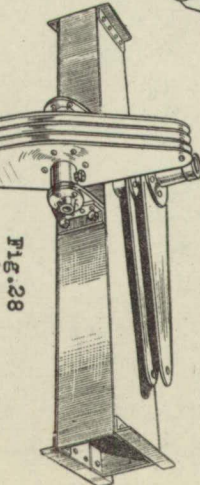


Fig.28

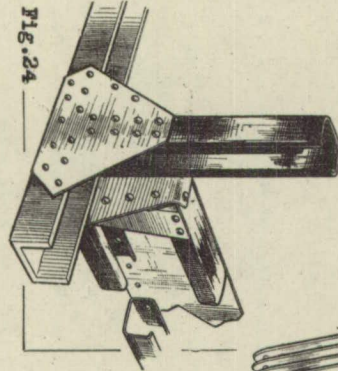


Fig.24

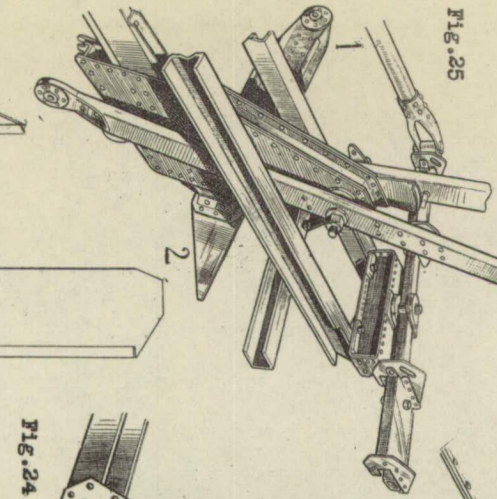


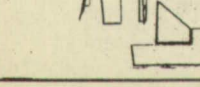
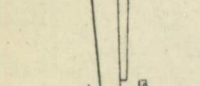
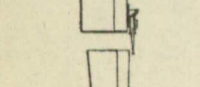
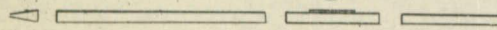
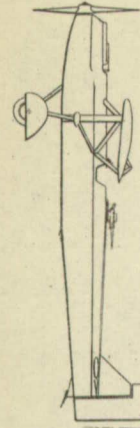
Fig.29

Fig. 30 Components parts of the W.E.L. 10. Wing in five sections and fuselage in three

Fig. 29 Assembly of the W.E.L. 10 observation airplane

Scale, ft.

Echelle
Scale, m





Figs. 31 & 32 Views of the Weymann-Lepere W.E.L. 10 observation airplane with a 650 hp Hispano-Suiza engine.